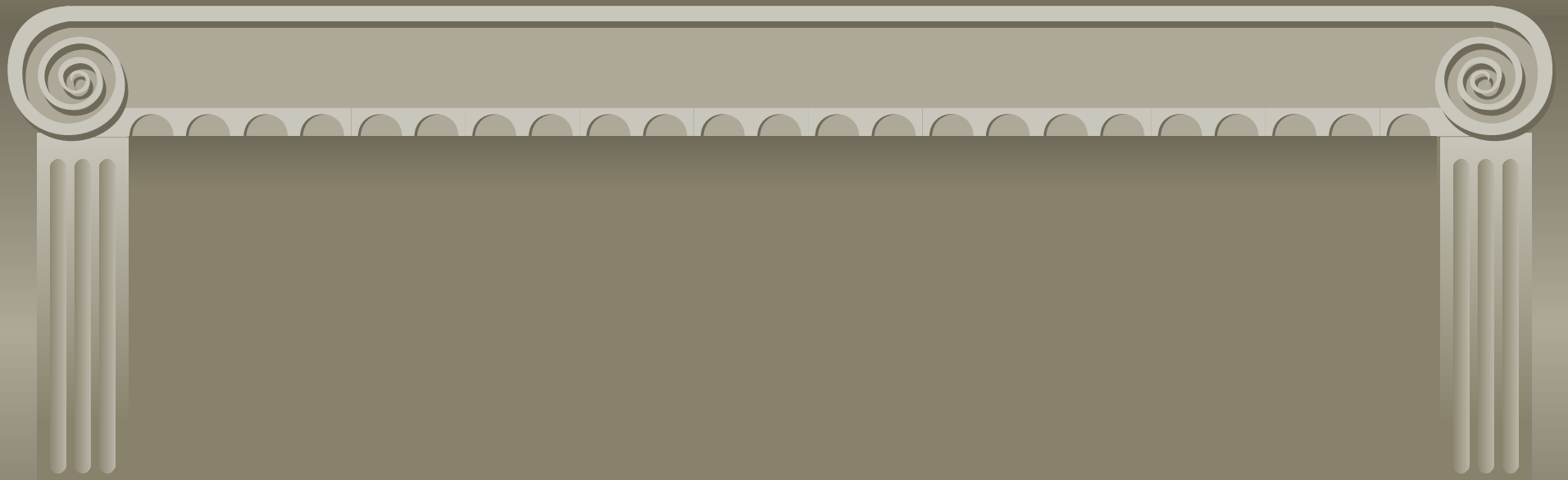
# DATA TRANSFER



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# RISK ASSESSMENT: *Low*

SAFETY CONSIDERATIONS:

*Electrical Shock Hazard*

*Electrostatic Discharge*

ENVIRONMENTAL CONSIDERATIONS:

*None*

# TERMINAL LEARNING OBJECTIVE

**ACTION: Communicate how the 8086 microprocessor transfers data.**

**CONDITIONS: Given a classroom environment, Computer Aided Instruction (CAI), workstation, NIDA electronic trainer, and official OMEMS reference material.**

**STANDARDS: Correctly answer 18 of 25 questions on the 8086 microprocessor transfers data.**

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# ENABLING LEARNING OBJECTIVE

**ACTION: Explain 8086 microprocessor immediate data transfer operations.**

**CONDITIONS: Given a classroom environment, Computer Aided Instruction (CAI), workstation, NIDA electronic trainer, and official OMEMS reference material.**

**STANDARDS: Correctly answer 18 of 25 questions on the 8086 microprocessor transfers data.**

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# PARTS OF AN INSTRUCTION

- Instructions have two parts an op code and an operand . For example, if the instruction is B8 1F10.
  - The Op Code is B8
  - The Operand is 101F
  - Op code specifies what operation is to be performed.
  - Operand contains the address of the data or the actual data to be used by the instruction.

# Types of data transfer

- Immediate (Op code w/Data)
- Direct (Op code w/Address)
- Indirect (Op codes only)

# IMMEDIATE TRANSFER

An immediate data transfer instruction consists of an opcode in the first byte followed by data in one or more of the succeeding bytes.

**The data to be transferred is in the instruction.**

# MVI r, byte (Move immediate Data to Register)

| CODE | MNEMONIC | PSEUDOCODE |
|---|---|---|
| B0 | MVI AL, 11 | MOVE 11 INTO |
| 11 | | THE AL REGISTER |

# MVI r, Word (Move immediate Data to Register)

| CODE | MNEMONIC | PSEUDOCODE |
|---|---|---|
| B8 | MVI AX, 1122 | MOVE 1122 |
| 22 | | INTO THE AX |
| 11 | | REGISTER |

# MVI M, byte (Move immediate Data to Memory)

| CODE | MNEMONIC | PSEUDOCODE |
|---|---|---|
| C6 | MVI M, AA | MOVE AA INTO |
| 06 | MEMORY | |
| 22 | LOCATION 1122 | |
| 11 | | |
| AA | | |

# MVI M, word (Move immediate Data to Memory)

| CODE | MNEMONIC | PSEUDOCODE |
|---|---|---|
| C7 | MVI M, | MOVE BBAA |
| 06 | BBAA | INTO MEMORY |
| 22 | | LOCATION 1122 |
| 11 | | |
| AA | | |
| BB | | |

## MVI DATA TRANSFER OPERATION

**Starting at address *1000*, move 1122h into *BX*, Move AAh into the *AL*. Move 1234 into memory location *1810*. Halt the program**

| ADDRESS | OP CODE | MNEMONIC |
|---|---|---|
| 1000 | | MVI BX, 1122 |
| 1001 | | |
| 1002 | | |
| 1003 | | MVI AL, AA |
| 1004 | | |
| 1005 | | MVI M (1810) (1234) |
| 1006 | | |
| 1007 | | |
| 1008 | | |
| 1009 | | |
| 100A | | |
| 100B | | HALT |
| 100C | | |

# ENABLING LEARNING OBJECTIVE

**ACTION: Explain 8086 microprocessor direct data transfer operations.**

**CONDITIONS: Given a classroom environment, Computer Aided Instruction (CAI), workstation, NIDA electronic trainer, and official OMEMS reference material.**

**STANDARDS: Correctly answer 18 of 25 questions on the 8086 microprocessor transfers data.**

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# DIRECT TRANSFER

- Unlike immediate transfers, direct transfer instructions contain the address or register where the data needed is stored or where the data is to be stored.

# **LAD** address (**L**oad **A**ccumulator **D**irect)

| **CODE** | **MNEMONIC** | **PSEUDOCODE** |
|---|---|---|
| *C7* | *MVI M, 1234* | *Move immediate to* |
| *06* | *memory location* | |
| *00* | *1000, 1234* | |
| *10* | | |
| *34* | | |
| *12* | | |
| **A1** | **LAD 1000** | **Load contents of** |
| **00** | | **1000 into the AX** |
| **10** | | **register.** |

# **STA** address (**S**tore Direct from **A**ccumulator )

| **CODE** | **MNEMONIC** | **PSEUDOCODE** |
|---|---|---|
| *B8* | *MVI, AX 1234* | *Move immediate into the AX* |
| *34* | *register 1234* | |
| *12* | | |
| **A3** | **STA 1000** | **Store contents of** |
| **00** | | **AX register into** |
| **10** | | **memory location** |
| **1000.** | | |

# **MOV** r1, r2 (Move Direct from Register to Register)

| CODE | MNEMONIC | PSEUDOCODE |
|---|---|---|
| *B8* | *MVI AX, 1234* | *Move immediate* |
| *34* | *into the AX 1234* | |
| *12* | | |
| 8B | MOV BX, AX | Move contents of |
| D8 | | AX register into |
| | | BX register |

## DIRECT DATA TRANSFER OPERATION

Starting at address *2200*, load contents of memory location 117Fh into *AX*. Move contents of *AX* into *BX*. Store contents of *AX* into memory location 5000h. Halt the program

| ADDRESS | OP CODE | MNEMONIC |
|---|---|---|
| 2200 | | LAD 117F |
| 2201 | | |
| 2202 | | |
| 2203 | | MOV BX, AX |
| 2204 | | |
| 2205 | | STA 5000 |
| 2206 | | |
| 2207 | | |
| 2208 | CD | HALT |
| 2209 | 20 | |

# ENABLING LEARNING OBJECTIVE

**ACTION: Explain 8086 microprocessor indirect data transfer operations.**

**CONDITIONS: Given a classroom environment, Computer Aided Instruction (CAI), workstation, NIDA electronic trainer, and official OMEMS reference material.**

**STANDARDS: Correctly answer 18 of 25 questions on the 8086 microprocessor transfers data.**

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# INDIRECT TRANSFER

Indirect data transfers require the memory location of the data to be stored in the SI, DI, BP or BX registers. The register must be loaded with the memory location before an indirect transfer can be performed. Indirect transfers have two bytes in the instruction. The second byte indicates which register contains the memory location: **[SI-04**], **[DI-05], [BP-06] & [BX-07]**

# MOV r, M (Move to Register from Memory)

| CODE | MNEMONIC | PSEUDOCODE |
|---|---|---|
| 8B | MOV AX, M | Move contents of |
| 04 | | memory location |
| | specified by *SI* | into AX register |

***04 indicates the SI register.***

# MOVM, r (Move to Memory from Register)

| CODE | MNEMONIC | PSEUDOCODE |
|---|---|---|
| *B8 34 12* | *MVI AX, 1234* | *Move immediate into the AX Register 1234* |
| *BE 50 50* | *MVI SI, 5050* | *Move immediate into the SI memory location 5050.* |
| **89 04** | **MOV M, AX** | **Move contents of AX to a memory location specified by the SI** |

***04 indicates the SI register.***

# INDIRECT DATA TRANSFER OPERATION

Starting at address *3000*, move F07Fh into *SI*. Move 6000 into *DI*. Move data from memory location specified by *SI* to memory location specified by *DI*.

| ADDRESS | OP CODE | MNEMONIC |
|---|---|---|
| 3000 | | MVI SI, FO7Fh |
| 3001 | | |
| 3002 | | |
| 3003 | | MVI DI, 6000h |
| 3004 | | |
| 3005 | | |
| 3006 | | MOV AX, M [SI] |
| 3007 | | |
| 3008 | | MOV M [DI], AX |
| 3009 | | |
| 300A | CD | HALT |
| 300B | 20 | |

# MOVEMENT OF DATA

- We can move data from:
- MEMORY TO REGISTER
- REGISTER TO MEMORY
- REGISTER TO REGISTER
- NOT MEMORY TO MEMORY

# SUMMARY

- Parts of an instruction
  - Op Code
  - Operand
- Types of instructions
  - Immediate
  - Direct
  - Indirect
- Movement of data
  - Not memory to memory